

# THE ANNALS

AND

## MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

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“..... per litora spargite muscum,  
Naiades, et circum vitreos considite fontes :  
Pollice virgineo teneros hic carpite flores :  
Floribus et pictum, divæ, replete canistrum.  
At vos, o Nymphæ Craterides, ite sub undas ;  
Ite, recurvato variata corallia trunco  
Vellite muscosis e rupibus, et mihi conchas  
Ferte, Deæ pelagi, et pingui conchylia succo.”  
*N. Parthenii Giannettasii* Ecl. 1.

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I.—*On the Morphology of some Amphipoda of the Division  
Hyperina.* By C. SPENCE BATE, F.R.S., F.L.S., &c.

[Plates I. & II.]

THE changes that the Crustacea pass through in their passage from the earliest larval condition to the adult form, have been looked upon as among the most interesting features in their history. Changes that assume a character approximating to what some have termed metamorphosis have only been recognized in the development of the Podophthalmous and Entomostracous forms, while the intermediate orders, known as the Edriophthalma, have been known to vary little in form between the parent and the larva. Milne-Edwards and Gosse have both indicated that some more than ordinary difference of form exists between the adult and young animals belonging to some genera of the division Hyperina; but their observations do little more than show that an exaggeration of one part takes place at the expense of another, and that some of the least important organs have yet to be developed.

It is not my intention to allude here to the development of *Hyperia*, since there will be an opportunity for that in the work on the British Sessile-eyed Crustacea, shortly to be published.

The favourable opportunities afforded me for the study of this division of the Amphipoda while engaged upon the Catalogue

for the British Museum (which is near its completion) have enabled me to make some observations that certainly in one direction must extend our knowledge of these creatures. In the collection of unexamined Amphipoda that was kindly entrusted to me by M. Milne-Edwards, belonging to the Museum of the Jardin des Plantes, were specimens of three species, each bearing young animals within the incubatory pouch. These species fortunately belong to three separate genera, namely: *Vibilia*, Edwards; *Platyscelus* and *Brachyscelus*, mihi.

*Vibilia* has been described by Milne-Edwards; and there will be no occasion to do more than allude to those organs that exhibit a difference of form in the adult and the larva. The species is a new one, and may be recognized by the specific name of *V. Edwardsii*.

The superior antennæ consist of a peduncle formed of one long and two very short joints, and a flagellum formed of one short, broad, obtuse-pointed, compressed articulus. The inferior antennæ are short, and consist of two long joints and several short articuli. The gnathopoda are imperfectly complexly subchelate. The first two pairs of pereopoda are simple, and a little longer than the gnathopoda; the third and fourth pairs are twice the length of the preceding, and have the propodos nearly as long as all the other joints, with the anterior margin serrated; the fifth pair are shorter and more feeble in appearance than the third. The three anterior pairs of pleopoda are normal in form: the three posterior are flat, broad, biramous; rami lanceolate. Telson narrow and triangular.

Length  $\frac{1\frac{1}{2}}{10}$  inch. Larva  $\frac{1}{10}$  of an inch.

*Hab.* "Near Iles de Powel. *Expédit. de la Zélée*" (Label on bottle).

The larva of *Vibilia Edwardsii* has the peduncle of the superior antennæ consisting of three joints gradually decreasing in size, and a flagellum consisting of four articuli gradually decreasing in size, the two terminal being tipped with short hairs. The inferior antennæ consist of a single joint, cylindrical, short, and subapically tipped with two curved hairs. The gnathopoda are uniform, short, consisting of five subequally short joints and a narrow and obtuse terminal one. The first two pairs of pereopoda are longer than the gnathopoda, and are simple in form. The third pair are not much longer than the second, and have the carpus antero-distally produced into a long process; the propodos distally increases in diameter, and is latero-distally produced on each side of the articulation with the dactylos to a sharp point, the anterior surface being concave; the dactylos, when closed, impinges against the hollow of the propodos. The fourth pair resembles the third, except that the antero-distal angle of the

carpus is considerably more produced, reaching nearly to the extremity of the propodos; the propodos is long, having the anterior surface concave, and the infero-distal angles on each side produced to a point; dactylos half the length of the propodos, and terminating in a curved unguis capable of shutting into the concave surface of the propodos. The fifth pair are rudimentary, the last joint terminating subapically in an unguiculate spine. The pleopoda are but imperfectly developed, two or three pairs only being present, and these consisting of a peduncle and two inarticulate rami, which probably are those of the three anterior pairs. The telson is as broad at the base as the preceding segments, and terminates obtusely.

The earliest and latest stages of this creature offer a considerable degree of variation in some points. The form of the cephalon differs: in the adult it is truncate in front, oblique beneath; in the young the dorsal surface gradually declines to the anterior margin, which is on a line with the inferior surface of the cephalon. The superior antennæ in the adult consist of a peduncle of three short joints, and a long, broad, flat, internally concave, unarticulate flagellum, and are situated in the frontal surface of the cephalon; in the young they consist of six joints, decreasing gradually in length and breadth to the extremity, where they are tipped with four small stiff hairs; they are situated at the anterior extremity of the cephalon. The inferior antennæ in the parent are six- or seven-jointed, while in the young animal they are almost obsolete, consisting of a single joint of small dimensions tipped with two hairs. In the adult we find the gnathopoda strong, well-developed, and efficient grasping organs; in the young they still retain an embryonic condition, and exhibit none of the characteristics peculiar to their future form. The first two pairs of pericopoda bear a strong relative resemblance to one another, those of the young differing but little from those of the parent. The two succeeding pairs in the adult are long, and evidently formed for seizing upon certain substances and securing itself in position, while those of the young are not longer than those of the preceding pair; they are also capable of holding certain substances; but while they possess this power in common with the adult animal, the plan by which it is attained differs considerably. In the adult the long slender propodos has the anterior margin minutely serrated, and is capable of being bent against the anterior margin of the meros and carpus; and, to make the grasp more secure, it impinges between two short spines at the distal extremity of the carpus. In the young, the two pairs are not exactly uniform; they agree in character, but differ in degree and, perhaps, in power: in the fourth pair, the carpus has the anterior

distal angle produced nearly to the extremity of the propodos ; in the third, it does not reach to half that length ; in each the propodos is anteriorly hollowed and distally produced, so that the dactylos impinges between two processes, and terminates in a distinctly curved unguis. The fifth pair of pereiopoda, both in the adult and in the larva, are very short, appearing in the full-grown animal as a perfectly formed but feeble organ, whilst in the young they resemble an imperfectly developed appendage. In the young, none of the pleopoda are properly developed, and only two pairs are present, in an embryonic condition ; the telson appears as broad as the previous segments ; while in the adult the three posterior pairs of pleopoda are long and biramous, the telson being small and lanceolate.

PLATYSCELUS, nov. gen.

This genus agrees in every respect with Dana's genus *Dithyrus*, except that, after the basa in the third and fourth pairs of pereiopoda, the remaining joints are developed, whereas in *Dithyrus* they are wanting.

*Platyscelus serratus.*

Cephalon transversely ovate. Pereion broadly distended. Pleon narrow. Eyes occupying the entire lateral walls of the cephalon. Superior antennæ short, six-jointed ; the first three, or peduncle, stout ; the fourth, or first articulus of the flagellum, equally stout, truncate at the extremity, where stands a bunch of auditory cilia ; the last two articuli are narrow, and terminate sharply. Inferior antennæ short, four-jointed, the joints not inflected one upon the other, but lying extended and hidden beneath the cephalon. First pair of gnathopoda complexly subchelate ; meros broad ; carpus broad and long, the inferior margin anteriorly produced, and serrated both on the anterior and inferior margins ; propodos a long-ellipse, and strongly serrated both on the superior and inferior margins ; dactylos sharp and smooth. Second pair of gnathopoda formed upon the same type as the first, but longer and not quite so broad. First two pairs of pereiopoda simple, but having the posterior or flexible margins minutely serrated. Third pair of pereiopoda short, having the basos long, being as long again as broad ; anterior margin nearly straight, having the distal extremity serrated ; posterior margin arcuate, the internal surface concave ; the remaining joints scarcely more than half the length of the basos, and having the anterior or flexible margin serrated ; dactylos smooth, sharp. Fourth pair of pereiopoda having the basos extremely developed ; the anterior margin excavate, corresponding in form with the posterior of the preceding pair ; posterior

margin parallel with the anterior; distal extremity rounded; internal surface concave, near the centre of which the succeeding joints articulate, but altogether they are not more than one-fourth the length of the basos, and are serrated upon the flexible margin. Fifth pair of pereiopoda represented by a membranous scale, not unlike one of the branchiæ, but furnished at the extremity with a small tubercle. Three anterior pairs of pleopoda biramous; three posterior also biramous, but each ramus is developed into the form of a broad, thin, membranous plate. Telson as broad at the base as the preceding joint, and terminating obtusely.

Length  $\frac{3}{4}$  of an inch; of young,  $\frac{1}{20}$  of an inch.

Habitat unknown. Taken by M. Morrissette of Havre.

Having given a description of the form of the adult animal, it will be interesting to compare it with that of the young before it has quitted the care of the mother.

Animal long and narrow. Cephalon anteriorly produced, the apex recurved beneath. Superior antennæ nearly as long as the cephalon, two-jointed, and tipped with four hairs nearly as long as the last joint. Inferior antennæ single-jointed, the extremity tipped with four hairs. First pair of gnathopoda having the meros and carpus broadly developed, with the inferior angle of each rounded-off and furnished with a solitary hair; propodos not half so broad as the carpus, increasing in diameter towards the distal extremity, where a small concave palm is apparent; dactylos long and sharp. The second pair are uniform with the first. First pair of pereiopoda longer than the gnathopoda, simple in character, and having the meros, carpus, and propodos each furnished with a single hair at the infero-distal extremity. The second pair of pereiopoda are uniform with the first. The third pair is about the same length as the preceding, but having the basos broadly developed, increasing in diameter towards the distal extremity, where it is produced posteriorly beyond the point at which it articulates with the ischium; the ischium, meros, and carpus are all broadly developed, and the two latter are furnished with a single hair at the antero-distal angle; the propodos is very narrow, and the dactylos long. The fourth pair of pereiopoda are uniform with the third. Fifth pair as long as the preceding, having the basos long and narrow, being scarcely dilated at all, and the remaining joints, which articulate at the extremity of the basos, fully developed, except the dactylos, which exhibits the appearance of an arrest of development, forming, apparently, a rim round the extremity of the preceding joint. Three anterior pairs of pleopoda present, but not de-

veloped beyond the first two joints of each of the rami; three posterior more matured, consisting of a peduncle and two sharp styliform rami. Telson narrow and rounded.

The points in which the larva appears to differ most conspicuously from the parent are:—In the form of the cephalon, which is a broad ovate ball in the adult (the lateral walls encroaching upon the under surface and hiding both pairs of antennæ), while in the early form it is long and narrow, tapering to a point, near which, on the under surface, the superior antennæ are planted, while the inferior pair are a little posterior to these: though small, neither are covered by the lateral walls of the cephalon. The pereion in the parent is broad and flat, and the pleon considerably narrower, while in the larva they are both uniformly narrow throughout the entire length of the animal, tapering gradually towards the posterior extremity. The gnathopoda in the adult are complexly subchelate; while in the larva, if they can be said to assume ever so slightly the subchelate character, it is by the dilated form of the propodos, which, though broader at the distal extremity than the nearer, is not more in diameter than half the length of the dactylos, and therefore its prehensile capability must be feeble. The carpus, which in the adult is developed into a large projecting process that assists materially in perfecting the grasping power of the appendage, is in the larva rounded-off and not developed, the point of development being occupied by a solitary hair: a similar hair exists also upon the infero-anterior angle of the preceding joint. The first two pairs of pereiopoda, in the larva, may be recognized as the undeveloped future organs, differing as they do only in their more imperfect condition, being destitute merely of some of the adult armature. The two succeeding pairs of pereiopoda, which are developed upon one type, in the adult differ in their proportions, so as to appear to vary considerably in form, while in the larva they are uniform with each other in every respect; they differ from those of the parent in having their basa less developed, and the remaining joints considerably longer in relative proportion both to the size of the basos as well as to that of the animal. The fifth pair of pereiopoda in the adult are obsolete, being represented by a flexible membrane only, whilst in the young creature they are long, strong, and normally developed, like the previously described poda, except the peculiar and curious dactylos. In the adult, the three posterior pairs of pleopoda are membranous and foliaceous; but in the larva the rami are slender, sharp-pointed, and styliform. The telson, in the adult, is as broad at the base as the preceding segment of the pleon; in the larva it is much smaller.

## BRACHYSCELUS.

Cephalon anteriorly rounded. Eyes occupying the lateral walls, which encroach upon the inferior margin. Pereion not distended, nearly as deep as the cephalon, and not wider. Pleon nearly as broad as the pereion; fourth and fifth segments fused together. Antennæ obsolete or very rudimentary. Oral appendages membranous and rudimentary. Gnathopoda complexly subchelate. Pereiopoda having the basa of the three posterior pairs largely developed; fifth pair having the remaining joints not obsolete. Pleopoda biramous. Telson single.

*Brachyscelus crusculum.*

*Female.*—Animal round and smooth. Cephalon anteriorly depressed, rounded. Oral appendages consisting of two small, narrow, pointed foliaceous plates, having a quadrate membranous plate centrally placed behind them. First pair of gnathopoda short, having the carpus broader than long, inferior angle anteriorly produced, deeply serrated upon the anterior and inferior margins, teeth upon the inferior margin posteriorly serrated; propodos arcuate, inferior margin serrated; dactylos short, slender, and sharp. Second pair resembling the first, but slightly longer; carpus longer than broad, having the anterior margin directed obliquely forwards, and equal to the length of the carpus. First pair of pereiopoda simple, slender, finely serrated upon the posterior margin of the meros, carpus, and propodos. Second pair like the first, but longer, and serrated only upon the propodos. Third pair of pereiopoda having the basos long-quadrate, slightly tapering towards the distal margin, posterior margin slightly arcuate; ischium articulating at the extremity of the basos; remaining joints longer than the basos. Fourth pair having the basos broader than the preceding joint, posteriorly dilated, and tapering to the distal extremity, where it articulates with the ischium; remaining joints not quite as long as the basos; the anterior or flexible margin finely serrated, except the dactylos. Fifth pair having the basos ovate, not so broad as that of the fourth pair; remaining joints about half the length of the basos; carpus having the anterior or flexible margin finely crenulated; dactylos small, hooked, and sharp, apparently immobile. Antepenultimate and penultimate pairs of pleopoda articulating at the distal lateral extremity of the coalesced fourth and fifth segments: antepenultimate pair having the rami styliform, with the approximal margins serrated; penultimate having the rami subfoliaceous, lanceolate; ultimate having the rami foliaceous, ovate. Telson triangular, longer

than broad, as broad at the base as the preceding segment, and as long as the posterior pair of pleopoda.

Length  $\frac{3}{4}$  of an inch; young less than  $\frac{1}{20}$  of an inch.

It was taken by M. Morrissette of Havre, but unfortunately the habitat has not been recorded.

The specimen from which the above description was taken was found upon examination to have within the incubatory pouch many young, which could not very long before have quitted the protection of the egg-case. The following is a description of one of them:—

Cephalon long, and tapering anteriorly to a point. Pereion not laterally compressed. Pleon having the fifth segment not developed, or fused with the preceding. Eyes not visible. Superior antennæ on the inferior surface approximating to the anterior margin of the cephalon, consisting of five joints, the second and third being each half the length of the first; fourth longer than the two preceding, and narrower; fifth short, narrow and tapering. Inferior antennæ obsolete\*. Oral appendages rudimentary. First pair of gnathopoda well developed, tolerably robust, nearly chelate; carpus infero-anteriorly produced to a sharp point, reaching more than half the length of the propodos; propodos scarcely as broad as the carpus, having the inferior angle anteriorly produced to a sharp point, nearly as long as the dactylos; dactylos long, sharp, slender, curved. Second pair of gnathopoda like the first. First and second pairs of pereopoda uniform, simple; dactylos long, curved, and powerful. Third pair long and slender; basos not dilated; ischium short; remaining joints rather long, subequal; dactylos slender, curved. Fourth pair as long as the preceding, but developed into a cheliform organ; propodos having the antero-distal angle produced into a long narrow process, nearly as long as the dactylos; dactylos long, slender, and slightly curved. Fifth pair of pereopoda short; basos but little shorter than that of the preceding pair; ischium and meros subequal, short, not longer than broad; carpus as long again as the meros; propodos tapering, subapically tipped with a curved spine that represents the dactylos. Three anterior pairs of pleopoda consisting each of a peduncle and two rami, each ramus consisting of two articuli, one long, the second rudimentary, each articulus being tipped with two long hairs. Three posterior pairs of pleopoda likewise biramous, the rami being sharp, straight, styliform, and unequal, the inner ramus being the shorter: antepenultimate and penultimate pairs of pleopoda apparently attached to the latero-posterior extremity of the fourth segment of the pleon, the fifth segment being pro-

\* I have not, with careful scrutiny, been able to make them out.



bably fused with the fourth : ultimate pair of pleopoda attached to the latero-posterior margin of the sixth segment. Telson small, round, being not more than one-third the diameter of the sixth segment of the pleon.

In comparing the young with the parent, we find the differences to be very considerable. The cephalon in the latter is rounded in front, and the walls encroach upon the inferior surface, whereas in the former it is produced anteriorly to a long point. The pereion of the adult is laterally compressed, and the first two segments are much shorter than the following ; in the young the pereion is not laterally compressed, and all the segments are subequal. The pleon in the young resembles that of the adult, except that the telson, which in the latter is as broad at the base as the preceding segment, in the former is considerably narrower. In the adult, the eyes nearly fill the cephalon ; in the young they are inconspicuous\*. The antennæ in the adult are obsolete ; in the young the anterior pair are largely developed, while the posterior alone are wanting. The organs of the mouth in both the adult and young are of a very rudimentary character. The gnathopoda in both old and young are well developed, but of a very different formation. In the adult they are developed upon the Hyperine type, a little exaggerated in feature, but strictly specific in character ; the complexly subchelate condition of the organs could not be mistaken for that belonging to any other family ; the carpus is large and inferiorly produced, the extremity forming the process against which the dactylos impinges ; whilst the propodos is narrow, and appears to exist as a part of the mobile joint of the chelate organ, and is so described by most authors who have written on the *Hyperina*. In the young they do not assume the distinctly Hyperine type : although the carpus is inferiorly produced, the propodos is nearly as broad as the carpus, and has the inferior angle produced into a long and strong tooth, against which the dactylos impinges, and not against the inferior angle of the propodos, as is the uniform law in the *Hyperina* when they impinge at all. The first two pairs of pereopoda differ only in the relatively imperfect condition of the former,—the small spines on the posterior margin of the carpus and propodos of the adult being wanting in the undeveloped organ, whilst in the latter the dactylos is proportionally much longer than in the former. The third pair of pereopoda in the young are long and well-developed organs, being only distinguishable from the same in *Gammarina* by the absence of the squamiform distension of the posterior margin of the basos ; whilst those in the adult

\* This may partly arise from the animals having been long dead, and being preserved in spirits.

have the basos largely developed, and the remaining joints less so than the normal condition of these appendages generally. The fourth pair of pereiopoda in the young are developed in the character of a very perfect chela, bearing a very similar appearance to those of the preceding pair of pereiopoda in the genus *Phronima*; but in the adult *Brachyscelus* they approximate closely to the form and condition of the same organ in the genus *Platyscelus adult*, the basos being apparently monstrously developed at the expense of the rest of the appendage. The fifth pair of pereiopoda in the young are not half the length of the two preceding pairs, and, like them, have not the basos enlarged; the dactylos is represented by an immobile, curved, sharp spine: in the adult the same pair have the basos large, and the remaining joints very short and feeble, while the dactylos consists of a curved hook, apparently immobile. The three anterior pairs of pleopoda differ in the young from those of the adult by their immaturity and undeveloped character only; the three posterior, in the young, have the rami simply styloform, and unequal; in the adult the antepenultimate only exhibits inequality in the length and the styloid shape of the rami; the penultimate and ultimate are foliaceous and equal, the ultimate the more perfectly so. In the young the telson is small, whilst in the adult it is as broad at the base as the segment of the pleon immediately preceding, and extends as far as the terminal extremity of the ultimate pair of pleopoda.

Having noticed the changes which the young of these species pass through previously to attaining their final condition of maturity, it will be interesting to observe the relations which they bear to those of other genera and to the Amphipoda in general.

The great dissimilarity between the form of the adult and the young animal must strike the most casual observer. The great change in the two last-described forms is due to the immensely developed eyes of the adult compared with the almost invisible organs of the young, and to the monstrous growth of the basa of the third and fourth pairs of pereiopoda. The adult form that approximates the nearest to the young of these genera is that of the genus *Oxycephalus*, which bears so close a resemblance to the young of *Platyscelus* that they might readily be accepted as belonging to one genus. In *Oxycephalus* the cephalon is long, inferiorly concave, tapering anteriorly to a point; the pereion is not laterally compressed; the pleon has the first segment deeper than the two succeeding; the telson is long and tapering, and as broad at the base as the preceding segment. According to Milne-Edwards's figure in his 'Histoire des Crustacés,' pl. 30. fig. 10, and M. Guérin, "The eyes are large; the anterior an-

tennæ situated upon the inferior surface and within the anterior margin; each consists of several joints and articuli, which fold, like the letter **Z**, upon itself. The inferior pair are long, four-jointed, each joint being reflected upon the preceding." The gnathopoda are complexly chelate. The first two pairs of pereopoda are long and simple; the three succeeding have the basa moderately developed; but the fifth pair are short, and in some species almost rudimentary. The three posterior pairs of pleopoda have the rami short, sharp, and styliform.

On a comparison of the species of this genus with those of the young animals already described, the difference will be found to consist chiefly in the size of the eyes, the length of the antennæ, and the complexly chelate condition of the gnathopoda of *Oxycephalus*.

The young of *Oxycephalus* have not been observed; yet I cannot but suppose that they bear a considerable resemblance to the young of the genera described, seeing that these so closely approximate to the form of the adult animal. This idea appears to receive sanction from observation of the young of *Rhabdosoma*. The only female specimens of this genus that I have had the opportunity of examining carried the ova in an immature state in the pouch; but M. Guérin-Méneville has been more fortunate: when he was so obliging as to show me his valuable collection of Amphipoda, he drew my attention to the form of the young of *Rhabdosoma*, which he had figured among his drawings. His figure of the young of *Rhabdosoma* appeared to me to be a fair representation of an adult *Oxycephalus*. Without going into the details of its structure, I think we may conclude that the young of *Rhabdosoma* bears a general resemblance to the young of *Platyscelus*. Thus we may remark that the young of *Vibilia*, *Brachyscelus*, *Leptoscelus*, and *Rhabdosoma*—animals, in their adult condition, very unlike each other—bear a considerable resemblance to one another in their young state.

In speaking of the morphology of this group, it must not be confounded with that of the Decapod forms, where the young animal leaves the egg and the care of the parent in an embryonic condition, and where the organs that are obsolete or secondary in the adult are made subservient to the uses of the animal in its immature condition. The morphology of the Brachyura is due to the development of parts that in the early condition of the animal are not visible. The creature, starting upon its errand of life at too early a period for the true limbs to have been moulded to their useful form, makes use of others that can only be available to an animal in an immature or degraded state.

In the Amphipoda the young quit the egg with the perma-

ment or adult features present, but in an imperfect state, the process of development being as yet incomplete; and, as I observed in the "Report on the British Edriophthalma," in the British Association Reports for 1855, p. 55, "Although the resemblance to the parent is very considerable, yet it is by no means complete; and it is probable that several moults are undergone before the perfect development of the animal is matured." And, arguing from this datum only, we could subscribe to Milne-Edwards's theory, that the condition of the young animal first exhibits the form of the *family* to which it belongs, next the *genus*, and lastly it betrays the *species* from which it sprang. But this doctrine appears to be at variance with the character of development in the present division, unless we are to assume that the type of the family is to be found in the genus *Oxycephalus*, and not in *Hyperia*.

The young animal, when it quits the ovum, does not leave it in a larval condition, but assumes the form consistent with the characters of an adult animal; that is, its permanent organs are not in an embryonic or larval condition, as is the case with the *Zoë* of the Decapoda, but are present in a more or less perfectly developed state. Thus, the anterior antennæ in *Vibilia* exhibit a character in the young animal more consistent with the normal condition of these organs than is to be found in the adult, while the reverse is to be seen in the posterior antennæ. The gnathopoda appear, in the young animal, to exhibit features of an immature condition; whilst the pereopoda, with the exception of the fifth pair, exhibit the condition of fully-developed organs. That they differ from those of the adult is true; but, with the exception of a distinction in form, those of the young appear to be as efficiently developed organs as those of the parent. The fifth pair of pereopoda, in the young, have not assumed the complete form of the parent; neither have the appendages attached to the pleon. As in *Vibilia*, so in *Platyscelus*, we find some parts of the animal more advanced in the young stage than in the adult, whilst others, again, show that they have not yet attained their fully-developed condition. In this species the eyes are developed, in the adult animal, to a monstrous size, encroaching upon, filling, and enlarging the entire cephalon, and changing its form from that of a narrow flat projection to one that is laterally broadly ovate and frontally circularly developed—a change of form that appears to have been produced in order to permit the visual organs to attain their greatest increase of dimension. Both pairs of antennæ exhibit a more developed condition in the adult than in the young; and in this they differ from *Vibilia*, where the posterior pair only are in an embryonic condition, and bear a close resemblance to those of the young of this genus.

The gnathopoda in the young of *Platyscelus* possess less of the embryonic condition than those in the young of *Vibilia*, but the form approximates to that of a mature animal; they do not resemble those of the parent, but approach more nearly to those of *Hyperia* or *Lestrigonus*. The first two pairs of pereopoda, as in *Vibilia* and probably all the genera of the family, assume in the young the form of simple poda, and differ from those of their respective parents only in the relative proportion of parts and in the presence or absence of a few spines or teeth. Not so the third and fourth pairs. In the three genera to which this paper alludes, these assume a very different form in the young from that presented by the adult: in *Platyscelus* and *Brachyscelus* they exhibit a condition that would generally be accepted as more perfect than that of the adult; whilst in *Vibilia*, although the change is quite as great as in the preceding genera, their form in the parent appears adapted to fulfil similar conditions to those of that in the young, being apparently as complete for the purpose in the one as in the other, although bearing little or no resemblance. In *Platyscelus* and *Brachyscelus* their form and condition are altogether distinct, and must be different in kind as well as in degree. The fifth pair of pereopoda, in the genera under consideration, exhibit altogether depauperized features; and it is curious to observe, with this condition constant in the adult state, how variable are their forms in the young animals of the several genera. In *Vibilia* they are, in the adult, well formed, but slender and feeble; in the young they are robust, but embryonic in appearance. In *Platyscelus* they are rudimentary in the adult, but in the young, with the exception of the dactylos, they are as well developed as the preceding pair, and only differ from them in having a narrower basos; and in *Brachyscelus*, where they approximate somewhat to the form of the preceding pair in the adult, in the young they assume a somewhat abnormal condition. Thus, singular to say, in that genus in which the appendages are most rudimentary in the adult, they are most perfectly developed in the young; and, on the other hand, in that genus in which their character in the adult is most consistent with that of the preceding pairs of appendages, they are, in the young, the most aberrant and immature.

In judging of the changes that these animals undergo, they appear to consist in something more than simple development. The morphology of some of the parts is certainly as complete a change of one form to another as is conceivable. Admitting that the change of the cephalon from the long, flat, tapering process to the short globular lobe is but the result of the development of the eyes and the consequent growth or enlargement of one part at the expense of another, it cannot be the same with regard

to some of the appendages. For instance, the third and fourth pairs of pereopoda in *Vibilia* are, in the adult, of the same form, their most remarkable feature being that the propodos is nearly one-half the length of the entire limb; it is armed with minute spines upon the anterior or flexible margin, and is capable of being doubled back against the preceding portion of the limb, being rendered more securely prehensile by the presence of two lateral, short, stiff spines at the antero-distal extremity of the carpus, between which the propodos closes against the carpus. In the young, these same organs, while differing from those of the parent, also differ from each other, but only in degree, so that a description of one will serve for both. The carpus is antero-distally produced nearly to the entire length of the propodos—in the third pair not so much as in the fourth; the propodos is anteriorly concave, the antero-distal angles being anteriorly produced (one on each side of the dactylos) to a sharp point,—the dactylos, closing between them, falling into the anterior concave groove, its apex antagonizing with the extremity of the carpus, and thus forming a tolerably perfect but complex chela. This change is still more complete in the morphology of the fourth pair of pereopoda of *Brachyscelus*. In the adult the basos is broad and large, the remaining joints lying reflected against the basos being considerably the shorter; in the young the basos is long and narrow, consisting of but a normal portion of the limb, whilst the propodos is large, with the antero-distal angle produced to a considerable process, and forming a strong ramus against which the moveable dactylos is capable of striking,—thus forming a very perfect chela, and one assimilating to that of the third pair of pereopoda in the genus *Phronima*. In *Platyscelus* the alteration is less striking, though still extremely great. The fourth pair of pereopoda differ from the third in having the basos more largely developed; the five distal joints, which articulate near the centre of the basos, are scarcely one-third of its length, it being so monstrously enlarged as to equal the entire length of the pereion. In the young, the third and fourth pairs of pereopoda resemble each other, and bear a moderate resemblance to those of the adult form of *Brachyscelus*; that is, they differ from those of the parent by the monstrous development of the basos only.

Observing that such considerable and eccentric changes occur in the progress of the animals from the earliest form to that of the adult, and knowing that the law among the Amphipoda, even including the aberrant forms of *Caprella*, is, that the normal progressive development is a variation of degree only, I am induced to think that the unimpoverished type of these genera is to be found nearer to the young than to the adult form, and

that the latter is the result of development superinduced by peculiar conditions. Thus, several genera, the young of which start from a common type, undergo changes most opposite to each other in order to fulfil with advantage the conditions under which they are placed.

Our knowledge of the habits of the *Hyperina* is very limited. They have mostly been found dwelling in the gill-cavities of Medusæ; but the few specimens of *Rhabdosoma* of which the habitat has been recorded were taken swimming freely in the ocean. Whether or not this may be the habit of this very curious creature, I cannot say; but *Platyscelus*, *Brachyscelus*, and other allied genera are certainly animals which have undergone a deterioration of character, and the great alteration of parts is such as their permanent condition may have required. The small eyes of the type are produced into monstrous organs in order, we may assume, to make up for the depreciation of the light that reaches them through the transparent animals in the cavities of which they take up their abode. The basa of some of the pereopoda are developed to a monstrous degree, and at the expense of the remaining joints, inasmuch as the walking appendages are not required by animals that are not in a position to use them; while the great squamiform basa of the third and fourth pairs protect the entire range of ventral organs, as well as the ova and young.

The adult animals having departed from the typical character of Amphipoda, we must look for their nearest allies in the order through the relation which their young may hold with the more aberrant forms. This link is certainly to be found to exist in *Phoxus* and other genera of the subfamily *Phoxides*—a circumstance that points out to us a necessary emendation in the classification of these animals.

## EXPLANATION OF THE PLATES.

### PLATE I.

Fig. 1. *Vibilia Edwardsii*, female adult.

Fig. 2. Ditto, young.

*b*, anterior antennæ; *c*, posterior ditto; *h*, first pair of gnathopoda; *i*, second pair of ditto; *k*, *l*, first and second pairs of pereopoda; *m*, third pair of ditto; *n*, fourth pair of ditto; *o*, fifth pair of ditto.

Fig. 3. *Oxycephalus piscator*.

Fig. 4. *Rhabdosoma Whitei*: *b*, anterior antennæ; *d*, mandible; *h*, first pair of gnathopoda; *i*, second pair of ditto.

### PLATE II.

Fig. 1. *Brachyscelus crusculum*, female adult.

Fig. 2. Ditto, young.

*b*, superior or anterior antennæ; *g*, maxillipedes; *h*, first pair

of gnathopoda; *i*, second pair of ditto; *k, l*, first and second pairs of pereopoda; *m*, third pair of ditto; *n*, fourth pair of ditto; *o*, fifth pair of ditto; *s*, fourth pair of ditto; *t*, fifth pair of ditto; *u*, sixth pair of ditto; *z*, telson.

Fig. 3. *Platyscelus serratus*, female adult.

Fig. 4. Ditto, ditto, young.

*b*, anterior antennæ; *c*, posterior ditto; *h, i*, gnathopoda; *k, l*, first and second pairs of pereopoda; *m, n*, third and fourth pairs of ditto; *o*, fifth pair of ditto; *p*, first pair of pleopoda; *s*, fourth pair of ditto; *t*, fifth pair of ditto; *u*, sixth pair of ditto; *z*, telson.

## II.—Notes on Cambridge Palæontology.

By HARRY SEELEY.

### IV. Some new Upper Greensand Echinoderms.

#### *Hemiaster M<sup>c</sup>Coyii*.

Outline oblong, oval, slightly flattened at the anterior extremity, longer than wide; height two-thirds of the length. The most elevated part is a little behind the apex, the widest part a little anterior to the middle. The transverse section is oval. Upper side slightly convex, sloping down towards the anterior end. Under side slightly convex; the part anterior to the mouth depressed. Anal side nearly vertically truncated; anterior end round. Ambulacra straight, unequal, very slightly impressed. The odd ambulacrum is formed of straight zones, each composed of about a dozen pairs of round pores, which are placed obliquely and rather wide apart; the pores are close together. The anterior ambulacra consist of a similar number of pores, which are smaller and closer together. The posterior ambulacra are very short, the zones consisting of about four pairs of pores. Mouth transversely oval, bordered by a little groove, and placed in the anterior third of the shell. Anus oval. The fasciole is wide and 7-sided; it is angular posteriorly, with a short side anteriorly: the posterior and shorter pair of lateral sides is parallel; the granules of which it is formed are very dense, and only just visible to the naked eye. The shell is very thin, and covered with comparatively large tubercles.

This well-marked Urchin is so distinct as not to admit of comparison with any form with which I am acquainted. Its nearest relative is a more globular form which occurs with it.

Rare. Coll. University; J. Carter, Esq.

#### *Salenia* (? *Hyposalenia*) *Woodwardi*.

Round, greatly depressed. Ambulacral areas narrow and straight,